

# Skylab paved way for International Space Station

This month marks the 25th anniversary of the launch of the third and final crew to live aboard America’s first space station, Skylab.

The Skylab Orbital Workshop was launched with no crew on May 14, 1973. Subsequent crewed missions were launched later that year on May 25, July 28 and November 16. Mission objectives were to show that space station operations were medically feasible, define design requirements, and demonstrate science performance during long-duration flight.

The launch of the workshop was marred by the loss of its thermal/micrometeoroid shield during ascent. One of the main solar panels was also lost and the other pinned down. It reached orbit with inadequate electrical power and dangerously high temperatures inside. These problems, which threatened total loss of the mission, were overcome by the work of the engineering teams at JSC, Marshall Space Flight Center and their contractors.

The first crew was launched 10 days later than planned, but with a full set of equipment with which to erect a substitute for the heat shield and to free up the unextended solar panel. Their success showed the value of extravehicular activities for repair of orbiting spacecraft.

Skylab 2 crew members were Charles Conrad Jr., Paul Weitz and Joseph Kerwin. During their 28-day mission, the crew conducted solar astronomy and Earth resources experiments, medical studies and



NASA Photo SL4-143-4706

The Skylab space station cluster in Earth-orbit is shown as photographed from the Skylab 4 Command and Service Module during the final fly-around before returning home.

five student experiments. The crew returned to Earth on June 22.

“The in-flight medical experiments gave a very complete picture of the long-term effects of weightlessness on physiology,” said Kerwin. “The benefits of exercise as a countermeasure were dramatically demonstrated. Life support, diet and waste management design questions were answered, and the *Skylab Experience Bulletins* provided International Space Station designers a complete book of human factors guidelines.”

Alan Bean, Jack Lousma and Owen Garriott flew aboard Skylab 3. The crew

conducted extensive scientific and medical experiments during the 59-day mission, returning to Earth on September 25.

The last of the Skylab missions, Skylab 4, was also the longest – 84 days. Gerald Carr, William Pogue and Edward Gibson conducted numerous experiments, including an observation of the comet Kohoutek, before returning to Earth on February 8, 1974.

By successfully completing increasingly longer missions, Skylab’s crews demonstrated the capability to conduct long-duration, human-tended space operations. Also, resupply of space

vehicles, performed most recently during the shuttle-Mir missions and critical to the future operation of the International Space Station, was attempted for the first time with Skylab and proven to be effective.

Following the final human-tended phase of the Skylab mission, ground controllers performed some engineering tests of certain Skylab systems – tests that ground personnel were reluctant to do while crew were aboard. Results from these tests provided data on long-term degradation of space systems.

Upon completion of these tests, Skylab was positioned in a stable attitude and systems were shut down. It was expected that Skylab would remain in orbit eight to 10 years. However, in the fall of 1977, it was determined that Skylab was no longer in a stable attitude as a result of the effects of greater than predicted solar activity.

On July 11, 1979, the empty Skylab spacecraft reentered the Earth atmosphere, scattering debris over the Indian Ocean and Western Australia.

The Skylab program demonstrated that humans could live and work in space for extended periods of time, and it expanded humanity’s knowledge of solar astronomy well beyond Earth-based observations.

“Skylab was a prototype,” said Kerwin. “It was intended to pave the way for a permanent space station. Its designers and operators will take special pride in the future success of the International Space Station.” ■

# WSTF ISO certification extended into next century

By Ray Melton

The White Sands Test Facility passed a significant milestone in September with the completion of a successful audit to extend its ISO 9001 quality system certification into the 21st century.

White Sands originally achieved its certification in October 1995. It was the first NASA installation to accomplish certification under the rigorous international standard confirming that management policies and practices meet

the highest standards for production and service.

A representative of Det Norske Veritas, White Sands’ third-party registrar, performed the extension audit September 22-24, reviewing management, quality system, document control, internal audit, and corrective and preventive action systems to ensure documented practices met ISO 9001 requirements. In addition, for a more comprehensive sample, other aspects of the White Sands Quality System were

reviewed, including processes supporting Procurement, Customer Agreement, Process Control, and Control of Measurement Equipment. Only four minor nonconformances were identified during the audit, and those already are well into the corrective action process.

White Sands engineering functions were the major focus of the audit, as well as a review of institutional support activities provided for the White Sands Complex, the facility responsible for Tracking and Data Relay Satellite System ground control

activities. Base support functions were recently transitioned to the Test, Evaluation, and Maintenance contractor, AlliedSignal Technical Services. The ISO 9001 audit confirmed that the transition continues to progress smoothly.

White Sands will receive a new certificate to extend its ISO 9001 registration through September 2001, issued under a NASA-wide contract with DNV. As with the previous certification, DNV will perform periodic audits every six months. ■

Continued from Page 1

# STS-88 to begin construction of the space station

“We are bringing hardware from all over the world and assembling it in space with people from all over the world, working together despite different languages, different backgrounds, different customs and different ways of doing things. We are making that all work.”

With Cabana aboard *Endeavour* will be Pilot Rick Sturckow and Mission Specialists Nancy Currie, Jerry Ross, Jim Newman and Cosmonaut Sergei Krikalev. *Endeavour*’s crew will launch Dec. 3. Two weeks earlier, on Nov. 20, the first station component, the U.S.-owned, Russian-built Zarya module, will be boosted to orbit from the Baikonur Cosmodrome, Kazakstan, by a Russian Proton rocket. *Endeavour*’s mission will be to rendezvous with and capture Zarya using the shuttle’s robotic arm, controlled by Currie, and attach Zarya to Unity in the shuttle’s cargo bay. Ross and Newman will then perform three space walks in later days of the flight to hook up data, electrical and fluid lines between the two components and install additional exterior equipment.

After *Endeavour* departs, Zarya will act as a sort of space tugboat, providing Unity with early power, propulsion,

communications and the capability to dock via remote control with the third station component, the Russian-provided Service Module, an early living quarters scheduled to launch from Baikonur in July 1999. *Endeavour*’s flight begins a series of about 45 U.S. and Russian flights that will assemble the station during the next five years.

“STS-88 will be among the most complicated space shuttle missions we have ever flown, but at the same time it is probably among the simpler International Space Station assembly missions,” said STS-88 Lead Flight Director Bob Castle. “You will see a lot of things on this flight that will be common activities in assembly missions to come – manipulators moving large pieces around and then the crew performing several space walks to finish the connections.”

STS-88 will include a long string of firsts. For the first time, the shuttle crew will not have a direct line of sight toward a module they capture with the arm. Currie’s view of the Zarya during the robotic arm operations will be obstructed

by the Unity module and she will rely on TV views and a new, Canadian-developed “space vision system” for cues. The Zarya module, at 43,000 pounds, will be the most massive structure ever moved using the shuttle’s mechanical arm.

“We’re going to have elements that aren’t even built in the same country... mated together for the first time over 200 miles up,” Currie said. “It has been a very detailed and complex task to manufacture parts ... to that strict of a tolerance and to devise ways to test them on the ground to ensure their compatibility.”

The station’s five years of assembly in orbit will encompass hundreds of hours of space walks, and its success will depend on the practice and planning performed on the ground, explained Jerry Ross, who already has accumulated 23 hours of space-walking experience on previous shuttle missions.

“One way to describe what it’s like, flight after flight, is if you can imagine waking up on Christmas morning and Santa Claus has delivered a whole bunch of ‘to be assembled’ things to your kids, and you get out the instructions, sit there and just try to figure out ‘tab A in slot B’ and all that stuff,” Ross said.

Another first for STS-88 will be that Mission Control must coordinate with a Russian company, the Khrunichev Space and Rocket Center which built Zarya, that was not involved during shuttle-Mir missions.

“The team is ready. The crew is ready. The launch delays have been disappointing, but we have put them to good use and we are better prepared than we would have been. Now we are ready to go,” Castle said. ■

*‘On STS-88, we’re learning to work with a new set of people in Russia. We benefitted a lot from the Shuttle-Mir missions, but on those we worked mostly with RSC-Energia.’*

— Robert Castle